TRANSLATION OF THE FRENCH REPORT
French Patent Application No FR 0209814

A. CLASSIFICATION OF SUBJECT MATTER granted by the French Patent Office
B23Q5/027

B. FIELDS SEARCHED
B23Q
F16H

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No
A	US 2 946 232 A (JONES GORDON H) July 26, 1960 (1960-07-26) * column 2, line 53 – column 3, line 52 ; figures 1-5 *	1-6
A	US 4 554 842 A (WOOD III DAVID B) November 26, 1985 (1985-11-26) * abstract ; figures 2, 3 *	1
A	GB 1 041 793 A (ASQUITH LTD WILLIAM) September 7, 1966 (1966-09-07) * the whole document *	1
A	US 4 714 388 A (SILER G DANIEL) December 22, 1987 (1987-12-22) * column 2, line 10 – column 4, line 44 ; figures 1-6 *	1

Categories of cited documents :

"X" document of particular relevance even when the document is taken alone.
"Y" document of particular relevance when the document is combined with one or more documents.
"A" general state of the art.
"O" non written disclosure.
"P" document published prior to the filing date but later than the priority date claimed.

"T" principle or theory underlying the invention.
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"&" document member of the same patent family.

Date of the actual completion of the search	Examiner : Ljungberg, R
March 14, 2003	

1,041,793

PATENT SPECIFICATION

DRAWINGS ATTACHED

1,041,793

Inventor: REGINALD LONGBOTTOM

Date of filing Complete Specification: May 28, 1963.

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Complete Specification Published: Sept. 7, 1966.

Index at acceptance:—F2 Q(7A3E, 7A3H)

Int. Cl.:—F 06 h

COMPLETE SPECIFICATION

Improvements in Rack and Pinion Mechanisms

We, WILLIAM ASQUITH LIMITED of High-road Well Works, Halifax, in the County of York, a British Company, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

In a rack and pinion drive there must be some clearance between the teeth of the rack and those of the pinion to accommodate the inaccuracies of the teeth, and this clearance results in lost motion when the drive is reversed, or unstable motion when overhauling loads are applied. This disadvantage can be reduced if two pinions are provided, both in mesh with the rack, one for driving in each direction.

However, the disadvantage cannot be entirely eliminated simply by providing two pinions in mesh with a single rack, and the present invention is designed to provide means whereby backlash in a rack and pinion drive can be eliminated or at least substantially reduced.

According to the invention in a rack and pinion drive two pinions are in driving engagement with a rack, each rack pinion being driven through one of a pair of driving pinions on a driving shaft, one driving pinion having helical teeth and being movable axially relatively to the other or fixed driving pinion, means being provided for urging the axially movable driving pinion in one direction whereby the two rack pinions will be rotatably biassed in opposite directions due to the tooth angle of the axially movable driving pinion, so that the teeth of one rack pinion are in engagement with one side of the rack teeth and the teeth on the other rack pinion are in engagement with the other side of the rack teeth, the driving mechanism for the axially movable driving pinion being arranged to provide frictional resistance to axial movement of the axially movable pinion, when under driving load, greater than the end thrust created on the axially movable pinion. Preferably, both driving pinions have helical teeth of the same hand relatively to one another.

In order that the invention may be clearly understood and readily carried into effect, a rack and pinion drive according to the invention, will now be described, by way of example only, with reference to the accompanying drawings in which:—

Figure 1 is a diagrammatic elevation, of the mechanism, and

Figure 2 is a sectional plan view,

Referring to the drawings, one particular arrangement according to the invention, will now be described by way of example only. In this particular example, two pinions 10 and 11, the rack pinions, are engaged with a rack 12 at longitudinally spaced apart positions on the rack. Each rack pinion 10,11 is secured to a gear 13 and 14 respectively which will be termed the intermediate gears, and each intermediate gear is in mesh with one of two driving pinions 15 and 16 on a driving shaft 17. The driving pinion 16 is mounted on splines on the driving shaft 17, the driving shaft is axially movable, and the said driving pinion is prevented from axial movements by means of a thrust bearing 18. The other driving pinion 15 is fixed on the driving shaft 17 so as to move axially with the shaft, and will be termed the axially movable driving pinion. This axially movable driving pinion 15 has helical teeth and consequently the intermediate gear 13 with which it engages also has helical teeth.

The driving pinion 16 has an axially extending sleeve 19 the interior of which forms a cylinder for a piston 20 on the driving shaft 17, the outer end of the sleeve cylinder being closed by a plug member 21, carried by a housing in which the gearing is mounted. A pipe 22 connected to a source of fluid under pressure (not shown) is connected to a pipe connector 23 secured in an opening in the

[*Price 4s. 6d.*]

plug member 21 for the supply of fluid under pressure to the sleeve cylinder to act on the piston 20. The fluid under pressure therefore urges the driving shaft 17, and the axially movable driving pinion 15, in one direction. This axial movement or biasing of the driving shaft 17, and the helical tooth angle of the axially movable driving pinion 15, is such as to bias the two rack pinions 10 and 11 in opposite directions, so that when the driving shaft 17 is rotated, the drive will be taken by one or the other of the rack pinions according to the direction of rotation of the driving shaft 17.

The arrangement so far described will function as a rack and pinion drive without any backlash, provided that the fluid pressure exerted on the end of the driving shaft is sufficient to balance the end thrust on the axially movable pinion 15 due to the driving load, but as this fluid pressure in some circumstances may require to be relatively high, it is preferred that the mechanism should be so arranged that a relatively low fluid pressure only is necessary, sufficient to bias the rack pinions to engage opposite sides of the rack teeth when little or no load is being applied. This can be effected by applying the drive through an axially fixed member having a splined connection with the driving shaft 17. In this particular construction the drive is applied to the axially fixed driving pinion 16 by means of a driving gear 24 secured to the axially fixed driving pinion 16, so that the axially movable driving pinion 15, which is fixed on the driving shaft 17, receives its drive via the splined connection between the axially fixed driving gear 16 and the driving shaft 17. When a load is applied by the driving gear 24 to the axially fixed driving pinion 16, to rotate the driving shaft 17 by reason of the splines on which the said driving pinion is mounted on the driving shaft, the said driving pinion 16 will become locked to the driving shaft due to the friction on the splines, and so will lock the driving shaft 17 against axial movement, and consequently, as the axially movable driving pinion 15 is fixed on the driving shaft, the said axially movable driving pinion will be locked against axial movement relatively to the axially fixed driving pinion 16. Consequently, when the gearing is at rest, with no driving load applied, the low fluid pressure will serve to displace the driving shaft 17 and the axially movable driving pinion 15 to cause the rack pinions 10 and 11 to engage with opposite sides of the rack teeth, and when a driving load is applied, the two driving pinions 15 and 16 will be locked relatively to one another on the driving shaft 17, and the drive will be transmitted, in either direction, without backlash.

As shown in Figure 2, the driving gear 24 is keyed on to the sleeve 19, the thrust bearing 18 engaging between a part of the casing which houses the gearing and a boss on the driving gear 24 thus preventing axial movements of the driving gear 24 and also the driving pinion 16.

WHAT WE CLAIM IS:—

1. A rack-and-pinion drive in which two pinions are in driving engagement with a rack, each rack pinion being driven through one of a pair of driving pinions on a driving shaft, one driving pinion having helical teeth and being movable axially relatively to the other or fixed driving pinion, means being provided for urging the axially movable driving pinion in one direction whereby the two rack pinions will be rotatably biassed in opposite directions due to the tooth angle of the axially movable driving pinion, so that the teeth of one rack pinion are in engagement with one side of the rack teeth and the teeth on the other rack pinion are in engagement with the other side of the rack teeth, the driving mechanism for the axially movable driving pinion being arranged to provide frictional resistance to axial movement of the axially movable pinion, when under driving load, greater than the end thrust created on the axially movable pinion.

2. A rack-and-pinion drive as claimed in Claim 1, in which the driving mechanism includes an axially fixed driving member and an axially movable driven member there being a splined connection between the two which provides the necessary frictional resistance to axial movement of the axially movable member when the driving mechanism is transmitting driving torque.

3. A rack-and-pinion drive as claimed in Claim 1 or Claim 2, in which the axially movable pinion is secured to the driving shaft and the means for urging the said pinion in one direction is operative on the driving shaft.

4. A rack-and-pinion drive as claimed in any one of Claims 1 to 3, in which hydraulic means are provided for urging the axially movable pinion in one direction.

5. A rack-and-pinion drive as claimed in any one of Claims 1 to 4, in which the axially fixed driving pinion has a splined connection with the driving shaft, and a driving gear is secured to the said axially fixed driving pinion.

6. A rack-and-pinion drive according to Claim 4 or Claim 5, insofar as it is dependent on Claim 4, in which one end of the driving shaft is axially slidable in a cylinder and fluid under pressure is supplied to the cylinder to act on the end of the driving shaft.

7. A rack-and-pinion drive according to Claim 6, in which a piston is provided on the said end of the driving shaft and is slidable in the cylinder, the fluid under pressure acting on the said piston.

8. A rack-and-pinion drive as claimed in any one of Claims 1 to 8, in which both driving pinions have helical teeth.

9. A rack-and-pinion drive according to Claim 1, substantially as described with reference to the accompanying drawings.

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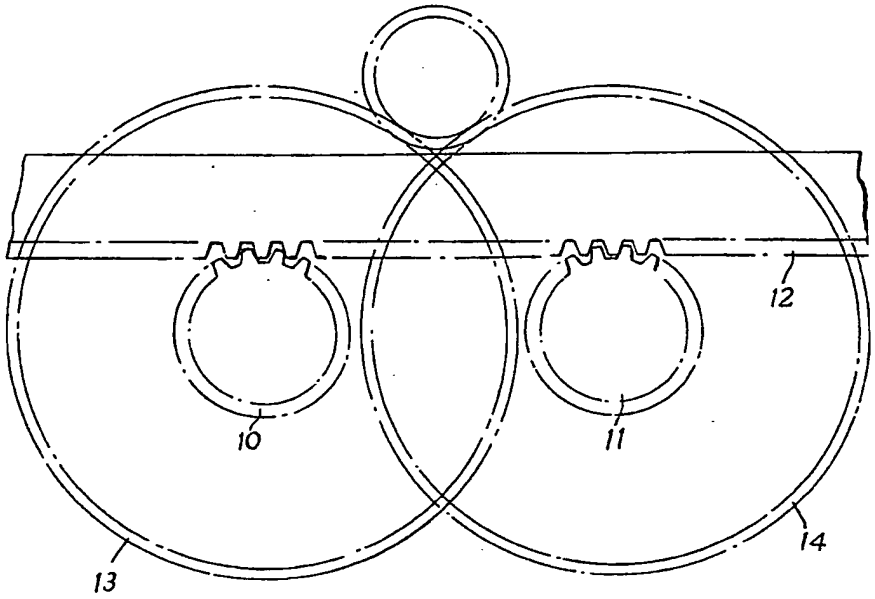

Fig.1.

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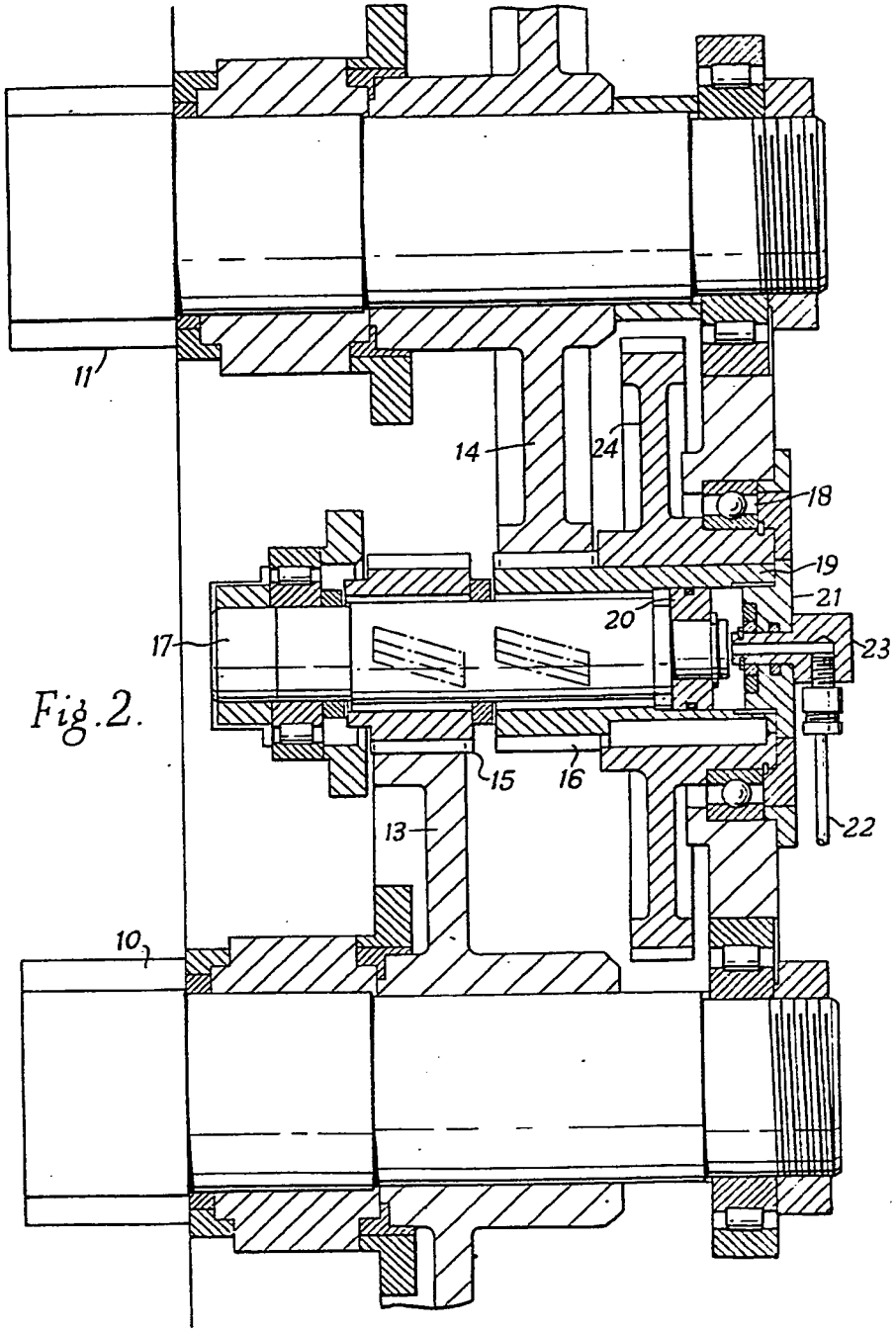

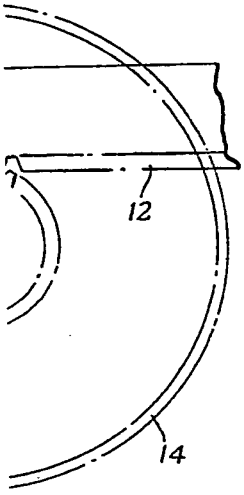

Fig. 2.

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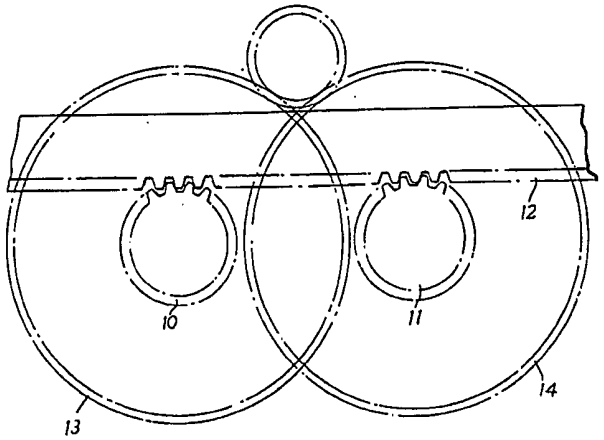

Fig.1.

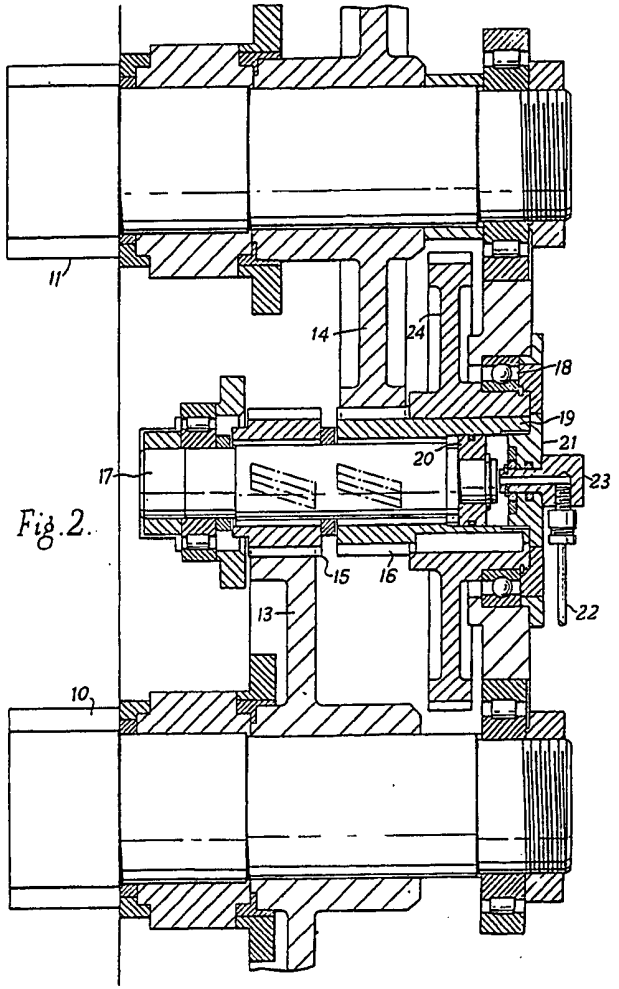

Fig.2.